What is claimed is:

1. A signal transmitting apparatus, which transmits signals to a plurality of receiving apparatuses using multi-antennas, the transmitting apparatus comprising:

a **V** generator, which generates a beamforming matrix **V** for a predetermined channel;

a water filling unit, which does not perform water filling for a training signal that is pre-known by the receiving apparatuses, and performs water filling for a user signal to be transmitted, the water filling being performed using the **V** matrix and predetermined control values;

a **V** operation unit, which multiplies a signal output from the water filling unit by the **V** matrix, and transmits the multiplied result through the multi-antennas; and

a control value detector, which extracts the control values from signals received from the receiving apparatuses through the multi-antennas, and outputs a maximum value among the extracted values to the water filling unit.

2. The signal transmitting apparatus as claimed in claim 1, wherein the control values are effective signal-to-noise-ratios (ESNRs).

3. A plurality of signal receiving apparatuses that receive, through multi-antennas, signals that are transmitted by a transmitting apparatus through a plurality of channels, each signal receiving apparatus comprising:

a channel estimation and $\mathbf{U}^H$ generator, which estimates a state of a channel through which a training signal has been passed, and processes the estimated channel state information to generate matrices including a receiving side unitary matrix $\mathbf{U}^H$ for the channel if the training signal is pre-known by the transmitting apparatus,

an $\mathbf{U}^H$ operation unit, which decodes by multiplying a signal received through the multi-antennas by $\mathbf{U}^H$; and

an effective-signal-to-noise-ratio (ESNR) calculator, which calculates an ESNR from noise detected during the decoding and the matrices, except the $\mathbf{U}^H$, and outputs the ESNR to the transmitting apparatus through the multi-antennas if the signal received through the multi-antennas is the training signal that is pre-known by the transmitting apparatus.

4. The signal receiving apparatus as claimed in claim 3, wherein processing of the estimated channel state information is by singular value decomposition.

5. The signal receiving apparatus as claimed in claim 3, wherein the ESNR is calculated using the following equation:

$$ESNR = \frac{A_1 V_{ii}}{A_1 \sum V_{ij(i \neq j)} + N^2} ,$$

wherein the matrices, except $\mathbf{U}^{\mathbf{H}}$, are a channel gain matrix $\mathbf{A}_1$ and a beamforming matrix $\mathbf{V}_{ij}$ respectively, and N denotes the noise.

6. A signal transmitting and receiving system in which signals are transmitted and received between a transmitting apparatus and a plurality of receiving apparatuses, the transmitting apparatus and receiving apparatuses each including multi-antennas,

the signal transmitting apparatus comprising:

a **V** generator, which generates a beamforming matrix **V** for a predetermined channel;

a water filling unit, which does not perform water filling for a training signal that is pre-known by the receiving apparatuses, and performs water filling for a user signal to be transmitted, the water filling being performed using the **V** matrix and predetermined control values;

a **V** operation unit, which multiplies an output signal of the water filling unit by the **V** matrix, and transmits the multiplied result through the multi-antennas; and

a control value detector, which extracts the control values from a signal received from the receiving apparatuses through the multi-antennas, and outputs a maximum value among the extracted values to the water filling unit, and

each of the signal receiving apparatuses comprising:

a channel estimation and $\mathbf{U}^H$ generator, which estimates a state of a channel through which the training signal has been passed, and processes the estimated channel state information to generate matrices including a receiving side unitary matrix $\mathbf{U}^H$ for the channel if the training signal is received;

an $\mathbf{U}^H$ operation unit, which decodes by multiplying a signal received through the multi-antennas by the $\mathbf{U}^H$; and

a control value calculator, which calculates a predetermined control value from noise detected during the decoding and the matrices, except the $\mathbf{U}^H$, and outputs the calculated result to the transmitting apparatus through the multi-antennas if the signal received through the multi-antennas is the training signal.

7. A signal transmitting method by which signals are transmitted to a plurality of signal receiving apparatuses using multi-antennas, the method comprising:

(a) setting a beamforming matrix $\mathbf{V}$ for a predetermined channel;

(b) operating the **V** matrix with a training signal that is pre-known by the signal receiving apparatuses and transmitting the operated result through the multi-antennas;

(c) receiving signals from the respective receiving apparatuses, extracting predetermined control values included in the received signals, and selecting a receiving apparatus having an optimal state for the channel by comparing the extracted control values; and

(d) transmitting a user signal to the selected receiving apparatus through the multi-antennas.

8. The signal transmitting method as claimed in claim 7, wherein the control values are ESNRs.

9. The signal transmitting method as claimed in claim 7, wherein (d) further comprises:

(d1) applying water-filling to the user signal using the maximum control value among the control values; and

(d2) multiplying the water-filling applied user signal by the **V** matrix and transmitting the multiplied result through the multi-antennas.

10. A signal receiving method in which signals transmitted from a transmitting apparatus through a plurality of channels are received using multi-antennas, the method comprising:

(a) a receiving apparatus receiving a training signal that is pre-known by the transmitting apparatus and estimating a state of a channel through which the training signal has been passed;

(b) processing the estimated channel state information to generate a plurality of matrices including a receiving side unitary matrix;

(c) decoding by multiplying the receiving side unitary matrix by the training signal; and

(d) calculating an effective-signal-to-noise-ratio (ESNR) using noise detected during the decoding and the matrices generated at (b), except the receiving side unitary matrix, and transmitting the calculated ESNR to the transmitting apparatus.

11. The signal receiving method as claimed in claim 10, further comprising:

(e) the transmitting apparatus receiving a user signal transmitted by the receiving apparatus; and

(f) decoding by multiplying the received user signal by the receiving side unitary matrix.

12. The signal receiving method as claimed in claim 10, wherein in (d), the ESNR is calculated by the following equation:

$$ESNR = \frac{A_1 V_{ii}}{A_1 \sum V_{ij(i \neq j)} + N^2},$$

wherein the matrices generated at (b), except the receiving side unitary matrix, are a channel gain matrix $\mathbf{A}_1$, a beamforming matrix $\mathbf{V}_{ij}$, respectively, and $\mathbf{N}$ denotes the noise.

13. A signal transmitting and receiving method by which signals are transmitted and received between a transmitting apparatus and a plurality of receiving apparatuses, the transmitting apparatus and receiving apparatuses each including multi-antennas, the method comprising:

(a) setting a beamforming matrix **V** for a predetermined channel in the transmitting apparatus;

(b) operating the **V** matrix with a training signal that is pre-known by the receiving apparatuses and transmitting the operated result through the multi-antennas;

(c) receiving the training signal and estimating a state of a channel through which the training signal has been passed, in the receiving apparatuses;

(d) processing the estimated channel state information to generate a plurality of matrices including a receiving side unitary matrix;

(e) decoding by multiplying the receiving side unitary matrix for the channel by the training signal;

(f) calculating an effective-signal-to-noise-ratio (ESNR) using noise detected during the decoding and the matrices generated at (d), except the receiving side unitary matrix, and transmitting the calculated ESNR to the transmitting apparatus; and

(g) the transmitting apparatus extracting the ESNRs from signals received from the receiving apparatuses, selecting a receiving apparatus having an optimal state for the channel by using the extracted ESNR values, and transmitting a user signal to the selected receiving apparatus through the multi-antennas.

14. The signal transmitting and receiving method as claimed in claim 13, further comprising:

(h) the selected receiving apparatus decoding by multiplying the received user signal by the receiving side unitary matrix.

15. The signal transmitting and receiving method as claimed in claim 13, wherein in (f), the ESNR is calculated by the following equation:

$$ESNR = \frac{A_1 V_{ii}}{A_1 \sum V_{ij(i \neq j)} + N^2},$$

wherein the matrices generated at (d), except the receiving side unitary matrix, are a channel gain matrix $\mathbf{A}_1$ and a beamforming matrix $\mathbf{V}_{ij}$, respectively, and **N** denotes the noise.

16. The signal transmitting and receiving method as claimed in claim 13, wherein (g) further comprises:

(g1) extracting the ESNRs from the signals received from the receiving apparatuses;

(g2) comparing the extracted ESNRs with each other to select a maximum ESNR;

(g3) applying water filling to the user signal using the maximum ESNR; and

(g4) multiplying the water-filling applied user signal by the **V** matrix, and transmitting the multiplied result through the multi-antennas.